In the Specification:

Paragraph [0019]

In a first aspect, the present invention provides a microfluidic array comprising bottomless through holes etched in a substrate. The geometry of the through holes is optimized from multiple aspects. The first aspect is that the geometry allows capillary forces to retain the fluid sample inside the through hole. The second aspect is the geometry allows gradients in electric field intensity, which allows fluid motion through the through holes. The third aspect of the geometry optimization is that the fluid miniscus between two substrates need to contact each other before the capillary forces of one through hole can affect the fluid in the other through hole. This is done by etching ~~lip~~ <u>collar</u> like structures to position the protrusion of one substrate in the recess of the other substrate. Also by keeping the hydrophobic outside coatings to encircle the through holes in the middle, with 5 - 500 micron gap between the edges of the through hole opening and the hydrophobic coating opening.

Paragraph [0030],

The microfluidic system 10 includes a substrate 14 having an array of through holes 16 as illustrated in FIG. 1. This substrate is any of the various materials such as silicon, quartz, glass, and plastics of cross linked and non crosslinked structures. The manufacturing method is described more in detail in the manufacturing issues section. Fluid samples and reagents 24 are introduced into the through hole arrays 16 by various physical and chemical means such as capillary action, meniscus contact between two fluid surfaces, pressure induced filling, vacuum induced suction, hydrophobic-hydrophilic induced forces and electrokinetic forces. The fluid samples 24 stays in place in the through holes due to capillary action and surface tension. Additional fluids 26 are introduced into the through hole array 16 by the capillary tubes 20 disposed in a second substrate 8, where the ends of

the tubes 20 terminate in tapered protrusions 18. The microfluidic system 10, as shown in Fig. 1 and 1A, the first substrate, 8 consists of atleast one peak, 18 protruding from the second surface of the substrate. The through-hole, 20 of the first substrate is in fluid communication with the tip of the peak, 18.

Paragraph [0031],

As shown in Fig. 1 and 1A, the microfluidic through-holes, 20 of the first substrate, 8 each reach the second surface at a peak, 18 protruding therefrom. The peak, 18 of the first substrate is operable to be partially accommodated within the microfluidic through-hole, 16. Each peak, 18 of the first substrate, 8 is operable to be at least partially accommodated within the microfluidic through-hole, 16 of the second substrate, 14 to make contact with the liquid, 24 retained therein. Protrusion 18 aligns substantially with through holes 16. In a preferred embodiement, top openings of through holes 16 are larger in diameter than the bottom openings of the through holes. Thus, through holes 16 may have conically tapered walls. The layer top openings of the through holes are sized and aligned to receive protrsions 18. Depending on the surface conditions, various fluid kinetics can occur. If the surface of the through hole 16 is hydrophilic, and the surface of tubes 20 hydrophobic, fluid 26 from tubes 20 moves into fluid 24 in 16 if the volume of through hole 16 can take the additional fluid. Only the amount of fluid that can fill up the volume of through hole 16 would be transferred. This fluidic motion causes both diffusive and laminar flow based mixing. Due to the laminar flow of 26 into 24, mixing times are dramatically short. If tube 20 is empty and the surface is hydrophilic and the surface of through hole 16 is hydrophobic, fluid 24 in 16 moves into the through hole 20 and fills up the volume of 20. This operation is due to the capillary forces in through hole 20, which moves the fluid from the through hole 16. If both the through holes 16 and 20

are hydrophobic or hydrophilic then only fluid diffusion occurs at the interface where the two fluids meet. A spacer structure 22 is maintained either on substrate 8 or 14. The spacer can be any thin or thick film of any material. The purpose of the spacers is to allow tiny air gaps between the substrates to maintain atmospheric pressure conditions on both sides of the fluidic plugs 24 and 20. Additionally hydrophobic coatings are maintained on the surfaces 27 and 28 to prevent fluids to wick to the surfaces. These coatings are patterned such that, the hydrophobic coating stops approximately 0.1 - 100 microns away from the through hole opening, giving rise to a hydrophyllic window opening that contributes to a fluid reservoir beyond the hole opening which prevents the meniscus becoming concave as evaporation proceeds.

Paragraph [0032],

In an alternate embodiment in FIG.2, a top substrate 12 having a plurality of through holes 16 having tapered walls are aligned with the through holes in a bottom substrate 13. The top substrate consists of etched through holes of straight or tapered walls. The bottom substrate also containes etched through holes of straight or tapered walls. The substrates have a coating of hydrophobic materials on the one or both sides 36. The hydrophobic window opening is larger than the through hole opening. This makes the fluid in the through hole to protrude out and cover the area up to the edge of the hydrophobic window. This enables the mixing of the two fluid meniscus despite the slow evaporation of the fluid through the through holes. In addition, one side of the through holes have a "~~lip~~ collar," 38 which allows lowering of the meniscus of one fluid into the other fluid. The ~~lip~~ collar structure consists of etched raised rings, which are formed by removing the substrate material outside of the rings, leaving a raised platform around the through hole opening on one side of the substrate. Without this "~~lip~~ collar ", after sufficient evaporation of the fluid, the fluid meniscus recedes into the through hole and at that point the